Fair and Equal:
School Funding and State-Level Racial Inequality of Educational Achievement

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Abstract
Racial segregation between districts has increased and funding inequality is arguably larger between rather than within districts and states. These trends suggest the importance of examining the relationship between education funding and racial inequality of educational achievement at the state-level, which incorporates inequality both within and between districts. Using 1990-2015 state-level NAEP data by race, linked to Census finance data and funding fairness data from the Education Law Center, I address two questions: Are White-Black achievement gaps related to education funding and the fairness of its distribution? Do these relationships vary by funding source? Results from models including state and year fixed effects suggest gaps depend more on local revenue than other revenue sources. However, achievement gaps depend more consistently on the fairness of revenue distribution than the revenue amount.

Keywords
Achievement gap, school finance, inequality, race, education

Introduction

Debates about how to reduce racial inequality in the U.S. have continued at least since the end of the Civil War. Some policy proposals specifically target racially exploited groups (e.g., affirmative action). Others are more inclusive or target the socioeconomically disadvantaged (low-SES), who disproportionately include racial minorities (e.g., Federal TRIO programs to improve access to higher education). Political distaste for policies that target racial minorities is illustrated by recent affirmative action lawsuits. Because they are more inclusive and more likely to pass (Skocpol 1995), racially neutral policies may hold more potential to reduce racial and ethnic inequality than those targeting specific racial groups (Wilson 1987).

Unfortunately, inclusive policies with the potential to reduce inequality (e.g., social security, the GI Bill, income-based school assignment, compulsory schooling) often increase it due to unequal situations and institutions (Powell 2008; Katznelson 2005; Reardon et al. 2006; Rauscher 2016). As efforts to increase educational equality move away from race-based affirmative action (Kahlenberg 1996, 2012; Espenshade and Radford 2009), we need to learn more about the implications of universal or (ostensibly) race-neutral policies for racial inequality.

Targeted universalism recommends that universal programs be targeted to increase racial equality by taking into consideration unequal relations to institutions and resources by race (Powell 2008). Using a targeted universalism approach, "Any proposal would be evaluated by the outcome, not just the intent" (Powell 2008:803). This approach is valuable, but depending on the nature of the targeting, could face the same risk of losing support as race-based policies. Using education funding as an example, providing additional funds for Black or Latino students (or schools with high proportions of Black or Latino students) could generate resentment or political backlash among White voters. To reduce this risk, a related approach could focus on the

outcome (with less attention on intent), to assess which policies reduce racial inequality with no (or minimal) explicit targeting of specific racial groups. As Coleman (1968) noted, we need to focus on equality of achievement outcomes rather than just inputs.

The question then becomes: which inputs can reduce racial inequality? Funding is arguably the key educational input. Teacher quality and student:teacher ratio may be more important for student learning (Darling-Hammond 2000; Schwartz et al. 2012; Schanzenbach 2014), but funding plays an important role in determining these more proximate inputs (Baker 2017). Though apparently race neutral, education funding may have stronger effects for minority students (Biddle and Berliner 2002) if they receive less academic input at home compared to majority students who are more socioeconomically advantaged on average (Alexander et al. 2007; Lareau 2003; Entwisle et al. 1998).

Beyond the amount of funding, however, two aspects of funding distribution may influence equality of achievement outcomes. First, states that distribute education funding more fairly may enjoy greater equality of achievement. If education funds disproportionately go to low-poverty districts at the expense of funds for high-poverty districts (i.e. if funding distribution is regressive), racial inequality could increase. Baker et al. (2015) note that the concentration of student poverty is critical for education funding because high poverty areas require higher spending to achieve the same outcomes. Given rising racial segregation between districts (Fiel 2013, 2015; Reardon and Owens 2014; Reardon et al. 2000) and higher poverty rates among Black compared to White students (Kids Count 2017), regressive or unfair funding distribution by student poverty rate could help White achievement and hurt Black achievement.

Second, funding from certain sources could be more efficient for increasing achievement, particularly among disadvantaged students. For example, state funding formulae in most states

(45 as of 2017) provide additional funds for "at-risk" students, who are typically defined based on family income-to-needs (e.g., National School Lunch Program eligibility) or unsatisfactory academic performance (Parker and Griffith 2016). Because students who meet these at-risk definitions are disproportionately African American (Kids Count 2017; Blanchett 2006; Losen and Orfield 2002; NCES 2017b, 2010; Aud et al. 2010; Musu-Gillette et al. 2017), this apparently race-neutral policy could reduce racial inequality of achievement. (Six states take into account English Language Learner or migration status when determining at-risk funding, but no states explicitly consider race [Parker and Griffith 2016].)

Taking seriously Coleman's (1968) argument to focus on equality of achievement outcomes, this study examines the implications of education funding for White-Black inequality of academic achievement. Specifically, I examine the following questions: 1) Are state-level White-Black achievement gaps related to education funding and the fairness of its distribution? 2) Do these relationships vary by funding source? To address these questions, I use state-level panel data on funding from the Census, funding fairness from Baker and colleagues (2016), and achievement from the National Assessment of Educational Progress (NAEP).

Theoretical and Empirical Background

Racial Achievement Gaps

Racial achievement gaps declined substantially after the 1950s (Magnuson and Waldfogel 2008; Reardon 2011; Jencks and Phillips 1998). More recently, however, we have experienced "stalled progress" on equality efforts (Magnuson and Waldfogel 2008). Part of this stalled progress could reflect a need to focus efforts between rather than within school districts. A great deal of educational and economic inequality is between school districts rather than within them (Fahle and Reardon 2017; Kozol 1991; Brown 2015; Owens et al. 2016). Furthermore, while racial segregation within school districts decreased after the 1950s

(particularly in the 1970s), racial segregation between school districts increased (Logan et al. 2017; Rivkin 2016; Whitehurst et al. 2016; Logan et al. 2008; Reardon et al. 2000; Clotfelter 1999). In fact, approximately 2/3 of racial school segregation is due to segregation between districts (Reardon et al. 2000; Stroub and Richards 2013). Given these trends, it is perhaps not surprising that between-district – and even between-state – inequalities in achievement and funding are arguably more drastic than those within districts (Brown 2015; Fahle and Reardon 2017; Baker et al. 2018).

Data advancements have allowed rapid improvements in understanding within-district inequality. The Stanford Education Data Archive, for example, provides valuable district-level achievement and achievement gap information on a national scale. These data are generating growing evidence about factors related to within-district inequality of achievement (Reardon 2018; Fahle and Reardon 2017; Shores and Steinberg 2017). For example, Reardon et al. (2018) find that nearly 90% of the variation in within-district achievement gaps is explained by local (within-state) factors. However, even if we eliminate these within-district achievement gaps, substantial inequality between districts could allow racial gaps in educational achievement to persist (Brown 2015; Fahle and Reardon 2017; Baker et al. 2018). Measuring inequality of achievement at the state level includes both between- and within-district inequality and allows examining variation at the same level as state policies.

Education Funding

State policy plays a large role in education funding because the federal government contributes a relatively small proportion of K-12 education funding (8%) and some states (e.g., California) cap the amount of revenue districts can raise locally (U.S. Department of Education 2005; Timar 2006; Kirst 2007). Furthermore, states vary greatly in the amount of funding they

provide per pupil and in the extent to which they redistribute local revenue to districts with higher poverty or lower property tax bases (Baker et al. 2018).

Despite an intuitive link between educational funding and student achievement, decades of evidence suggest little relationship (e.g., Hanushek 1989, 1996, 2001, 2003; Morgan and Jung 2016). However, this research typically focuses on average student outcomes (Hanushek 1989, 1996; Burtless 1996; Greenwald et al. 1996; see Biddle and Berliner 2002 and Baker 2016 for reviews). Education funding may have stronger effects for disadvantaged or minority students (Biddle and Berliner 2002) if they receive less academic input at home compared to more advantaged students (Alexander et al. 2007; Lareau 2003; Entwisle et al. 1998). Though apparently race-neutral, education funding could reduce racial inequality of achievement if learning opportunities for minority students are more likely to occur at school. In other words, achievement of minority students may depend more strongly on school resources, such as teacher quality, given unequal contexts outside of school.

Similarly, the cost of educating students varies by their characteristics. For example, students in poverty or in areas of high poverty concentration require additional investment to achieve the same level of achievement as other students (Baker et al. 2015, 2018). Therefore, how funds are distributed may be at least as important as the amount. By distributing funds more progressively to districts with higher poverty (and education costs), states may boost achievement more among disadvantaged students. Given rising racial segregation between districts (Fiel 2013, 2015; Reardon and Owens 2014; Reardon et al. 2000) and higher poverty rates among Black compared to White students (Kids Count 2017), progressive funding distribution by student poverty rate could help Black more than White achievement.

Finally, state, local, and federal funds could vary in their efficiency for increasing achievement, particularly among disadvantaged students. State funding formulae typically provide additional funds for disadvantaged, high-need, or special education students (e.g., through categorical or "at-risk" funds) and include rules that those funds have to be spent on programming for those students (Parker and Griffith 2016). Categorical funds are earmarked for students who are eligible for free or reduced-price lunch, learning English, have a learning disability, or in a vocational education program. Because students who meet these high-need categories are disproportionately African American (Smith et al. 2013; Kids Count 2017; Blanchett 2006; Losen and Orfield 2002; NCES 2017b, 2010; Aud et al. 2010; Musu-Gillette et al. 2017), this apparently race-neutral policy could reduce racial inequality of achievement.

Similarly, federal revenue targets districts with concentrated poverty (Title I) and students with special education needs (English Language Learners and students with an Individualized Education Program). Given unequal distribution of these categories by race, federal revenue may also reduce racial inequality of achievement despite being apparently race-neutral.

In contrast, evidence suggests that districts distribute local funding more unequally than state or federal funding (Timar and Roza 2010). When distributing unrestricted (non-categorical, including local) funds, districts favor schools with more advantaged students (Heuer and Stullich 2011; Timar and Roza 2010; Roza and Miles 2002). In fact, when examining the distribution of non-categorical funds, Roza et al. (2007) find that funding inequality within districts is greater than funding inequality between districts. Thus, when they receive more local revenue, districts may provide more resources (particularly higher salaries for more experienced teachers) to schools in neighborhoods with more socioeconomically advantaged and White students.

Because districts tend to distribute local funding more unequally than other sources, local revenue may hold the most potential to reduce inequality when distributed progressively. On the other hand, because state and federal revenue includes rules about allocation, more progressive distribution of those sources may increase equality the most.

Based on the above review, I identify the following hypotheses:

1) Revenue is related to lower White-Black inequality of achievement.
2) Progressive (fair) revenue distribution is related to lower White-Black inequality of achievement.
3) State and federal revenue are related to lower White-Black inequality of achievement and local revenue is related to higher inequality.
4) Progressive distribution of local revenue is most strongly related to lower White-Black inequality.

Methods

Data

I use state-level data from the National Assessment of Educational Progress (NAEP) to measure achievement in Reading and Math in grades 4 and 8. Table 1 shows the availability of state achievement by grade and year. NAEP provides state-level achievement separately by race, which allows me to calculate state-level achievement gaps as the percent difference of average Black achievement from average White achievement. Primary analyses predict standardized percent gaps one year after other measures (year t+1) to allow delayed benefits. Sensitivity analyses predict current-year gaps and gaps measured in raw NAEP scale points and the ratio of Black to White achievement.

I merge these data to 1987-2015 state-level F-33 education funding data (in constant 2015 dollars). Using these data, I measure total revenue per pupil, but also local, state, and federal revenue per pupil. I log these measures to reduce skewness and use standardized measures in the main analyses to allow comparison of coefficients.

Finally, I merge 1993-2015 state-level fairness measures (Baker et al. 2016). After adjusting for district characteristics, fairness is the ratio of predicted state and local revenue per pupil for a district with 30% poverty rate to a district with 0% poverty rate. Thus, it measures to what extent more revenue is directed toward districts with higher poverty and, therefore, higher costs of educating students. Fairness of distribution of revenue from state, local, and federal sources is measured similarly (the ratio of predicted per pupil revenue from each source for a district with 30% poverty to a district with 0% poverty).

Controls include funding effort (state and local educational spending divided by fiscal capacity), state share of total revenue, average family income among students enrolled in public school, coverage (percent of school-age children in public school), percent in charter school, and average daily attendance (logged to reduce skew). These measures are provided in the funding fairness data (Baker et al. 2016). To control for variation in inequality, I merge inequality indices from Frank (2014). Main analyses control for the Theil inequality index, but other measures yield consistent results.

Approach

I predict achievement gaps in models with education funding measures, controls, and state and year fixed effects. This approach estimates within-state changes in achievement gaps, taking advantage of variation in funding and variation in the fairness of funding distribution over time. Although state spending priorities, economic health, or demographics may relate to both education funding and achievement gaps, fixed effects adjust for constant state differences. Time-varying demographic and economic controls account for key changes over time that could relate to both education funding and achievement gaps. Year fixed effects account for changes over time that could affect all states (e.g., the 2008 recession).

$$\%\, Gap_{ij+1} = \beta_1 Revenue/Pupil_{ij} + \beta_2 Fairness_{ij} + \beta_k X_{ij} + State_i + Year_j + \epsilon_{ij} \quad (1)$$

Equation 1 predicts achievement gaps in year ($j+1$) with state (i) and year (j) fixed effects, per pupil revenue, funding fairness, and time-varying controls (X). β_1 tests hypothesis 1 and estimates the extent to which achievement gaps change with per pupil revenue. β_2 tests hypothesis 2 and estimates the relationship between achievement gaps and funding fairness. Separate models are also run with either revenue or fairness, but not both. To test hypotheses 3 and 4, I use standardized dependent and independent variables and specify revenue (and the fairness of its distribution) from state, local, and federal sources separately. Robust standard errors are adjusted for state-level clustering in all models.

Sensitivity analyses predicting current-year gaps and gaps measured in raw NAEP scale points and the ratio of Black to White achievement yield consistent results. Analyses including state-specific time trends yield consistent results, but estimates do not reach significance in some models. Results predicting gaps in reading achievement in grades 4 and 8 are shown below. Analyses predicting math gaps are provided in the online appendix.

Instrumental Variable Analyses

A potential concern in the main analyses is that state funding fairness could be endogenous to racial inequality of achievement. For example, states with less racial inequality may be more likely to distribute revenue progressively. Alternatively, some other factor such as the state economy could drive both state progressiveness and achievement gaps. To address this concern, an additional sensitivity analysis uses state supreme court decisions on school finance cases as an instrumental variable (IV). Specifically, I use state supreme court decisions and dates from Baker et al. (2016) and Rebell (2017) to predict the fairness of revenue distribution. I limit the sample to state-year observations after a supreme court decision (and therefore to states with at least one school finance court decision). The IV is coded one if the most recent court decision is in favor of more equitable or adequate funding.

Equation 2 shows the IV model. In the first stage, state funding fairness is regressed on the IV (most recent state supreme court decision), years since the most recent court decision (raw and squared, represented by *X*), and state and year fixed effects. Because court decisions take time to implement, state fairness is measured one year after the IV and other measures. In the second stage, achievement (also one year after the IV measure) is predicted by the instrumented fairness measure and the same controls as the first stage. Models are run with and without controlling for state revenue per pupil. Equation 2 predicts one-year lead achievement gaps measures, but two- and three-year lead measures are also predicted to allow implementation of court decisions to take longer. Robust standard errors are adjusted for state-level clustering in all models.

$$Fairness^{*}_{ij+1} = \beta_1 IV_{ij} + \beta_k X_{ij} + State_i + Year_j + \epsilon_{ij+1}$$

$$\%\, Gap_{ij+1} = \beta_1 Fairness^{*}_{ij+1} + \beta_k X_{ij} + State_i + Year_j + \epsilon_{ij+1} \quad (2)$$

As in the main analyses, results predicting gaps in reading achievement in grades 4 and 8 are shown below. IV analyses predicting math gaps are provided in the online appendix.

Results

Table 2 provides descriptive statistics for all state-year observations with finance and reading achievement data for grades 4 and 8. The mean inequality measures indicate that Black achievement is approximately 12% less than White achievement in grade 4, on average, whether measured as percent achievement gap or the ratio of Black to White achievement. This gap drops to 9% in grade 8. Descriptive information for math achievement is in Appendix Table A1. Math achievement gaps are comparable to those for reading, but increase slightly from 10% in grade 4 to 11% in grade 8. The different trends in achievement gaps over time could suggest that math inequality is cumulative and less amenable to change during schooling years.

Mean revenue is just over $13,000 per pupil (in 2015 dollars), which is very close to the national average of $12,903 in 2015 (Cornman et al. 2017:2). Federal revenue represents 9% of the total (close to the 8.5% national average in 2015; Cornman et al. 2017). Local revenue contributes 43.4% and state revenue contributes 47.8% of total revenue (close to the 2015 national averages of 45% and 46.5%, respectively; Cornman et al. 2017).

The mean progressiveness measure is approximately one, which suggests overall revenue distribution is neither progressive nor regressive. Values greater than one indicate that more funding is provided to high poverty districts than low poverty districts. Mean progressiveness measures by revenue source indicate that state and federal revenue are distributed progressively, while local revenue is distributed regressively, on average. Table 3 compares mean values among state-year observations with progressiveness values greater than one (labelled Fair) and less than or equal to one (labelled Unfair). Achievement gaps in grade 4 and 8 are smaller and the ratios of Black to White achievement are higher when funding distribution is fair. These differences are only significant at the 90% level in grade 4 and could reflect differences between states or over time.

Table 4 provides estimates of percent White-Black reading achievement gaps from fixed effects models accounting for constant differences between states and national changes in gaps over time. Coefficients for total revenue per pupil are positive, but not statistically different from zero. In contrast, progressiveness of funding distribution is consistently related to lower achievement gaps ($p<0.01$), with or without including revenue or time-varying state measures. The coefficients are in standard deviation units and suggest that a one standard deviation increase in progressiveness (0.24) is related to a decrease of about 1/5 of a standard deviation in the

White-Black achievement gap. Thus, as the funding ratio for high poverty to no poverty districts increases by 0.24, the White-Black gap decreases by about 6 or 7 tenths of a percentage point.

Panel B in Table 4 shows the same analyses when predicting 8th grade achievement gaps. Results are null for both revenue and progressiveness, suggesting that total revenue and the fairness of its distribution are not related to White-Black inequality of achievement in 8th grade. These results contradict hypothesis 1 and suggest no relationship between total revenue and White-Black achievement gaps. Evidence is consistent with hypothesis 2 – that progressive revenue distribution is related to lower gaps – for grade 4, but not grade 8.

To test hypotheses 3 and 4, Table 5 shows results disaggregating revenue by source. As in Table 4, coefficients for revenue predicting grade 4 achievement gaps (Table 5, Panel A) are consistently null, regardless of the source and whether including controls for state characteristics or progressiveness. In contrast, coefficients for progressiveness of the funding distribution are consistently negative. One standard deviation increase in progressive distribution of local revenue is related to a decrease in the gap of nearly 1/3 of a standard deviation in all models ($p<0.01$). Progressive state revenue distribution is related to similar declines in the achievement gap in most models, although the coefficient only reaches significance at the 90% level in Model 5 (including revenue measures but not state controls). Figure 1 compares estimates of the relationship between achievement gaps and the amount and distribution of revenue by source. Coefficients are in standard deviation units to allow comparison across models.

Panel B shows results predicting grade 8 achievement gaps. Consistent with grade 4 estimates, results suggest that progressive distribution of local revenue is consistently related to lower gaps ($p<0.01$). Coefficients range from about 1/5 to nearly 1/3 of a standard deviation (d = -0.22 to -0.29). As in Table 4, progressive federal revenue distribution is related to slightly lower

gaps, but coefficients are generally only significant at the 90% level. These patterns are consistent with hypothesis 4, that progressive distribution of local revenue is most strongly related to lower White-Black inequality.

The main difference when predicting gaps in grade 8 (compared to grade 4) is that local revenue is related to lower gaps in one model. Specifically, in Model 2 (Table 5 Panel B) including state controls, one standard deviation increase in local revenue per pupil ($3,450) is related to 4/5 of a standard deviation decrease in the White-Black gap (about 3 percentage points or 24% of the mean gap). The coefficient is smaller and only marginally significant in Model 6, which controls for progressiveness of revenue from each source. These results contradict hypothesis 3. Coefficients for state and federal revenue are generally null (or only marginally significant for federal revenue in two models predicting grade 8 gaps) and coefficients for local revenue are either null or negative. Thus, local revenue is not related to higher inequality. If anything, it is related to lower gaps in grade 8.

Results predicting math achievement gaps (shown in the appendix) are consistent with the finding that achievement gaps decline with higher progressiveness, particularly higher progressiveness of local and state funding distribution. However, coefficients typically become smaller and insignificant when adding controls. This suggests that progressive revenue distribution is more strongly related to lower gaps in reading than math achievement. This could reflect differences in the teacher labor market for reading and math teachers, with higher turnover and retention costs among math teachers compared to reading teachers (Worth and De Lazzari 2017; West 2013; Chingos and West 2012). Alternatively, it could reflect the pattern of rising mean achievement gaps in math from grade 4 to 8. This pattern is consistent with evidence that math achievement is cumulative (Siegler et al. 2012; Balfanz et al. 2007), so differences

before grade 4 could persist or grow regardless of revenue. Either way, results suggest that progressive revenue distribution holds more potential to reduce achievement gaps in reading than math.

Sensitivity Analyses

Results are robust to a series of sensitivity analyses, including adding state-specific time trends and predicting alternative measures of inequality. Panel A in Table A4 suggests that results are robust to including state-specific time trends when predicting achievement gaps in grade 4 reading. Panel B suggests that total revenue per pupil is related to lower gaps in grade 8 reading when including time trends. However, similar to the main analyses predicting math gaps, results are null when including state time trends in models predicting math achievement gaps.

Results are robust to predicting the ratio of Black to White achievement as well as current-year gaps (as opposed to gaps one year after other measures). These estimates are shown in Tables A5 (current-year gaps) and A6 (ratio measures). As in the main analyses, models predicting current-year gaps suggest that progressive distribution of local revenue is related to lower achievement gaps in 4^{th} and 8^{th} grade reading. When predicting current-year math gaps, results suggest local revenue (amount rather than distribution) is related to lower gaps. As discussed in the main analyses, this pattern could reflect labor market differences for reading and math teachers. If quality math teachers are more expensive to recruit and retain (West 2013; Chingos and West 2012), the amount of local revenue may take precedence over its distribution for inequality of math achievement.

The ratio of Black to White achievement is essentially the same measure as percent difference in Black from White achievement, but may be more intuitive to interpret. Because the measure is nearly the same as percent gaps, but greater equality is represented by higher values,

it is not surprising that estimates in Table A6 are the same magnitude as those in the main analyses, but of opposite sign.

Instrumental Variable Analyses

Results of the instrumental variable analyses are presented in Table 6. When predicting reading achievement gaps in grade 4 (Panel A), progressive revenue distribution consistently reduces White-Black gaps ($p<0.05$). Whether predicting achievement gaps one, two, or three years after the court decision, more progressive revenue distribution reduces White-Black gaps. Specifically, a one standard deviation increase in progressiveness reduces White-Black gaps by 2/3 of a standard deviation one year after the court decision, at least one standard deviation two years later, and about 3/4 of a standard deviation three years later. These estimates range from 18% to 34% of the mean gap, depending on the model.

In Panel B, predicting 8th grade reading gaps, progressiveness is related to lower achievement gaps, but coefficients do not reach significance until three years after the court decision. Specifically, when controlling for total revenue per pupil (Model 6), one standard deviation increase in progressiveness reduces the White-Black gap in 8th grade reading by nearly 2/3 of a standard deviation (2 percentage points or 18% of the mean gap) three years after the court decision. Whether predicting gaps in grade 4 or 8, estimates dwarf those for revenue. Thus, IV analyses further support hypothesis 2, that progressive revenue distribution is related to lower White-Black achievement gaps.

Conclusion

In the context of declining support for race-based affirmative action to reduce educational inequality (Kahlenberg 1996, 2012; Espenshade and Radford 2009), this study examines the implications of two ostensibly race-neutral policies for racial inequality: the amount and

progressiveness of education funding. Funding is arguably the key educational input and the resources funds can buy could increase achievement more among Black students (Biddle and Berliner 2002) if they receive less academic input at home compared to White students who are more socioeconomically advantaged on average (Alexander et al. 2007; Lareau 2003; Entwisle et al. 1998). Furthermore, progressive revenue distribution provides more revenue per pupil to school districts with higher poverty rates. Given unequal poverty rates by race (Kids Count 2017) and substantial racial segregation between districts (Fiel 2013, 2015; Reardon and Owens 2014; Reardon et al. 2000), apparently race-neutral funding policies could hold potential to reduce racial achievement gaps.

Using 1990-2015 state-level NAEP data by race, linked to F-33 Census data and funding fairness data from the Education Law Center, this study finds that White-Black achievement gaps depend more consistently on the fairness of revenue distribution than the revenue amount. Results for reading achievement gaps hold when using state supreme court decisions to instrument fairness, including state-specific time trends, and alternative inequality measures. IV estimates suggest that progressive funding distribution can have delayed effects, with the largest reductions in achievement gaps appearing two or three years after a supreme court decision.

Although local revenue is distributed more unequally than federal and state revenue, progressive distribution of local revenue is most strongly related to lower White-Black inequality. Furthermore, although total revenue is rarely related to achievement gaps, local revenue is related to lower gaps in some models. This suggests that more and fairer distribution of local revenue may hold potential to reduce White-Black achievement gaps.

These results should be interpreted with limitations in mind. First, this study examines state-level achievement gaps, which include inequality both within and between districts. This

has benefits, given rising racial segregation (Fiel 2013, 2015; Reardon and Owens 2014; Reardon et al. 2000) and substantial economic inequality between districts (Fahle and Reardon 2017; Kozol 1991; Brown 2015; Owens et al. 2016). However, future research could examine the extent to which these results reflect relationships between revenue and achievement gaps between or within districts.

Second, the main analyses include state and year fixed effects to adjust for constant differences between states and for national changes over time. These estimates can establish an association, but not a causal relationship. The instrumental variable analyses help reduce concern that the relationship between funding fairness and achievement gaps could be driven by some other factor. However, additional research is needed to establish a causal relationship.

If future research supports these results, they have implications for education policy. First, the fair distribution of revenue – particularly local revenue – may be more important for reducing racial achievement gaps than the amount of revenue. Second, class-based (ostensibly race neutral) policies can reduce racial inequality of educational achievement in the current context of socioeconomic inequality by race. Third, inequality of math achievement is less responsive to progressive revenue distribution and may require earlier or alternative interventions. By focusing on equality of achievement outcomes (Coleman 1968), we can learn more about which inputs have potential to reduce racial inequality.

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Table 1: Years of State-Level NAEP Data by Subject and Grade Level

Level	Math	Reading
Grade 4	1992, 1996, 2000, 2003, 2005, 2007, 2009, 2011, 2013, 2015	1992, 1994, 1998, 2002, 2003, 2005, 2007, 2009, 2011, 2013, 2015
Grade 8	1990, 1992, 1996, 2000, 2003, 2005, 2007, 2009, 2011, 2013, 2015	1998, 2002, 2003, 2005, 2007, 2009, 2011, 2013, 2015

Table 2: Descriptive Statistics: Reading Achievement

	Grade 4		Grade 8	
Variables	Mean	Std Dev	Mean	Std Dev
% White-Black Gap	11.95	3.52	9.29	2.14
Black:White Ratio (x100)	88.05	3.52	90.71	2.14
Revenue/Pupil	13143.63	3588.68	13312.03	3457.86
Local Revenue/Pupil	5698.45	3451.89	5684.46	3140.12
State Revenue/Pupil	6282.26	2226.99	6390.51	2161.25
Federal Revenue/Pupil	1221.21	530.81	1248.84	497.44
Progressiveness of Revenue Distribution	1.02	0.24	1.02	0.25
Progressiveness - Local Revenue	0.60	0.26	0.59	0.24
Progressiveness - State Revenue	1.71	1.12	1.77	1.18
Progressiveness - Federal Revenue	5.63	3.55	5.64	3.33
State & Local Educ Spending/Fiscal Capacity	0.04	0.01	0.04	0.01
State Share of Total Revenue	0.63	0.21	0.64	0.20
Family Income (Enrolled in Public School)	72782.88	16216.43	72970.53	16342.88
Coverage (% School-Age in Public School)	0.87	0.03	0.87	0.03
% in Charter School	0.02	0.04	0.02	0.04
Average Daily Attendance	1002697	1104098	1056323	1135048
Gini Coefficient	0.59	0.04	0.59	0.04
Year	2005.27	6.11	2006.54	5.08
Last State Supreme Court Case Pro-Fair*	0.42	0.50	0.41	0.49
Years Since Last Court Decision*	6.80	5.42	6.98	5.38
N	412		354	
N *	196		181	

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness data, Frank (2014) 1990-2013. Sample is limited to state-year observations with achievement gap, revenue, and fairness information.

Table 3: Descriptive Statistics by Progressive Distribution: Reading Achievement

	Grade 4		Grade 8	
Variables	Mean	Std Dev	Mean	Std Dev
% White-Black Gap	11.95	3.52	9.29	2.14
Black:White Ratio (x100)	88.05	3.52	90.71	2.14
Revenue/Pupil	13143.63	3588.68	13312.03	3457.86
Local Revenue/Pupil	5698.45	3451.89	5684.46	3140.12
State Revenue/Pupil	6282.26	2226.99	6390.51	2161.25
Federal Revenue/Pupil	1221.21	530.81	1248.84	497.44
Progressiveness of Revenue Distribution	1.02	0.24	1.02	0.25
Progressiveness - Local Revenue	0.60	0.26	0.59	0.24
Progressiveness - State Revenue	1.71	1.12	1.77	1.18
Progressiveness - Federal Revenue	5.63	3.55	5.64	3.33
State & Local Educ Spending/Fiscal Capacity	0.04	0.01	0.04	0.01
State Share of Total Revenue	0.63	0.21	0.64	0.20
Family Income (Enrolled in Public School)	72782.88	16216.43	72970.53	16342.88
Coverage (% School-Age in Public School)	0.87	0.03	0.87	0.03
% in Charter School	0.02	0.04	0.02	0.04
Average Daily Attendance	1002697	1104098	1056323	1135048
Gini Coefficient	0.59	0.04	0.59	0.04
Year	2005.27	6.11	2006.54	5.08
Last State Supreme Court Case Pro-Fair/Adequate*	0.42	0.50	0.41	0.49
Years Since Last Court Decision*	6.80	5.42	6.98	5.38
N	412		354	
N *	196		181	

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness data, Frank (2014) 1990-2013. Sample is limited to state-year observations with achievement gap, revenue, and fairness information. Fair is limited to observations with progressiveness of revenue distribution > 1; Unfair ≤ 1.

Table 4: Predicted White-Black Reading Achievement Gaps – Total Revenue and Progressiveness
Panel A: 4th Grade

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	% White-Black Gap - 1-yr lead sd					
Revenue/Pupil (log) sd	0.04	0.18			0.06	0.16
	(0.16)	(0.28)			(0.14)	(0.24)
Progressiveness State & Local Revenue/Pupil (log) sd			-0.17**	-0.21**	-0.17**	-0.20**
			(0.05)	(0.07)	(0.05)	(0.07)
State & Local Educ Spending/Fiscal Capacity		-33.77+		-26.30		-30.15
		(19.83)		(16.47)		(18.02)
State Share of Total Revenue		-0.29		-0.19		-0.38
		(0.62)		(0.52)		(0.58)
Family Income (Enrolled in Public School)		0.00		0.00		0.00
		(0.00)		(0.00)		(0.00)
Coverage (% School-Age in Public School)		-0.98		-0.08		-0.19
		(2.28)		(2.44)		(2.42)
% in Charter School		-0.67		-0.17		0.29
		(6.03)		(5.82)		(5.94)
Log Average Daily Attendance		0.45		-0.43		-0.01
		(1.26)		(1.23)		(1.30)
Gini Coefficient		-0.85		-1.42		-1.47
		(1.36)		(1.35)		(1.33)
Constant	0.88**	-3.59	0.85**	6.81	0.89**	1.73
	(0.16)	(16.83)	(0.08)	(17.12)	(0.15)	(17.51)
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	412	259	412	259	412	259
R-squared	0.40	0.16	0.42	0.20	0.43	0.20
Number of States	48	47	48	47	48	47

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness data, Frank (2014) 1990-2013. Sample is limited to state-year observations with achievement gap, revenue, and fairness information. All currency is in 2015 dollars. Revenue and progressiveness measures are logged to reduce skew. Variables labelled "sd" are standardized and measured in standard deviation units for comparison.

Robust standard errors adjusted for state clustering in parentheses. ** p<0.01, * p<0.05, + p<0.1

Panel B: 8th Grade

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	% White-Black Gap - 1-yr lead sd					
Revenue/Pupil (log) sd	-0.17	-0.51			-0.16	-0.51
	(0.17)	(0.31)			(0.17)	(0.31)
Progressiveness State & Local Revenue/Pupil (log) sd			-0.05	0.03	-0.05	0.01
			(0.06)	(0.06)	(0.07)	(0.06)
State & Local Educ Spending/Fiscal Capacity		-7.13		-19.55		-7.33
		(24.95)		(22.60)		(24.83)
State Share of Total Revenue		0.33		-0.38		0.32
		(0.58)		(0.58)		(0.58)
Family Income (Enrolled in Public School)		0.00		0.00		0.00
		(0.00)		(0.00)		(0.00)
Coverage (% School-Age in Public School)		-1.07		-1.82		-1.14
		(3.26)		(3.39)		(3.32)
% in Charter School		6.02		7.44		5.96
		(6.44)		(6.69)		(6.39)
Log Average Daily Attendance		-0.85		0.54		-0.81
		(1.65)		(1.37)		(1.66)
Gini Coefficient		-2.59		-2.71		-2.55
		(2.31)		(2.37)		(2.37)
Constant	0.10	12.98	0.19+	-3.68	0.10	12.63
	(0.16)	(22.51)	(0.11)	(19.23)	(0.16)	(22.60)
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	354	246	354	246	354	246
R-squared	0.09	0.12	0.09	0.10	0.09	0.12
Number of Sates	46	45	46	45	46	45

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness data, Frank (2014) 1990-2013. Sample is limited to state-year observations with achievement gap, revenue, and fairness information. All currency is in 2015 dollars. Revenue and progressiveness measures are logged to reduce skew. Variables labelled "sd" are standardized and measured in standard deviation units for comparison.

Robust standard errors adjusted for state clustering in parentheses. ** p<0.01, * p<0.05, + p<0.1

Table 5: Predicted White-Black Reading Achievement Gaps – Revenue and Progressiveness by Revenue Source
Panel A: 4th Grade

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	% White-Black Gap - 1-yr lead sd					
Local Revenue/Pupil (log) sd	0.04	0.20			0.17	0.30
	(0.19)	(0.32)			(0.18)	(0.28)
State Revenue/Pupil (log) sd	0.43	0.54			0.22	0.14
	(0.26)	(0.54)			(0.25)	(0.53)
Federal Revenue/Pupil (log) sd	0.06	0.07			0.05	0.06
	(0.14)	(0.18)			(0.13)	(0.16)
Progressiveness Local Revenue/Pupil (log) sd			-0.29**	-0.29**	-0.28**	-0.29**
			(0.07)	(0.07)	(0.07)	(0.08)
Progressiveness State Revenue/Pupil (log) sd			-0.20*	-0.38*	-0.18+	-0.36*
			(0.10)	(0.18)	(0.10)	(0.17)
Progressiveness Federal Revenue/Pupil (log) sd			-0.12	-0.14+	-0.13+	-0.15+
			(0.08)	(0.07)	(0.08)	(0.08)
State & Local Educ Spending/Fiscal Capacity		-35.64+		-24.22		-29.36
		(18.40)		(16.91)		(18.04)
State Share of Total Revenue		-0.43		-0.60		-0.57
		(0.75)		(0.55)		(0.75)
Family Income (Enrolled in Public School)		0.00		0.00		0.00
		(0.00)		(0.00)		(0.00)
Coverage (% School-Age in Public School)		-0.89		-0.25		-0.09
		(2.24)		(2.40)		(2.28)
% in Charter School		-0.78		-0.16		0.21
		(5.95)		(5.95)		(6.04)
Log Average Daily Attendance		0.68		-0.01		0.55
		(1.20)		(1.13)		(1.18)
Gini Coefficient		-0.99		-2.66+		-2.62
		(1.42)		(1.57)		(1.58)
Constant	0.93**	-6.41	0.81**	2.19	0.88**	-5.05
	(0.21)	(16.44)	(0.09)	(15.82)	(0.21)	(16.03)

State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	405	259	412	259	405	259
R-squared	0.40	0.16	0.44	0.23	0.44	0.23
Number of States	48	47	48	47	48	47

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness data, Frank (2014) 1990-2013. Sample is limited to state-year observations with achievement gap, revenue, and fairness information. All currency is in 2015 dollars. Revenue and progressiveness measures are logged to reduce skew. Variables labelled "sd" are standardized and measured in standard deviation units for comparison.

Robust standard errors adjusted for state clustering in parentheses. ** $p<0.01$, * $p<0.05$, + $p<0.1$

Panel B: 8th Grade

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	% White-Black Gap - 1-yr lead sd					
Local Revenue/Pupil (log) sd	-0.05	-0.81*			0.08	-0.58+
	(0.25)	(0.38)			(0.22)	(0.31)
State Revenue/Pupil (log) sd	-0.11	0.14			-0.26	-0.44
	(0.38)	(0.61)			(0.32)	(0.62)
Federal Revenue/Pupil (log) sd	-0.12	-0.26+			-0.15	-0.29+
	(0.16)	(0.15)			(0.15)	(0.15)
Progressiveness Local Revenue/Pupil (log) sd			-0.22**	-0.28**	-0.24**	-0.29**
			(0.08)	(0.08)	(0.08)	(0.10)
Progressiveness State Revenue/Pupil (log) sd			0.14	0.25	0.12	0.22
			(0.14)	(0.16)	(0.14)	(0.16)
Progressiveness Federal Revenue/Pupil (log) sd			-0.12+	-0.18*	-0.12+	-0.16+
			(0.06)	(0.08)	(0.06)	(0.08)
State & Local Educ Spending/Fiscal Capacity		-6.67		-16.22		-3.15
		(22.92)		(21.10)		(21.52)
State Share of Total Revenue		-0.97		-0.09		-0.10
		(0.99)		(0.62)		(1.01)
Family Income (Enrolled in Public School)		0.00		0.00		0.00+
		(0.00)		(0.00)		(0.00)
Coverage (% School-Age in Public School)		-1.87		-1.00		-0.58
		(3.32)		(2.90)		(3.10)
% in Charter School		6.92		10.52+		9.61
		(6.29)		(5.97)		(5.95)
Log Average Daily Attendance		-0.61		0.84		-0.49
		(1.44)		(1.25)		(1.35)
Gini Coefficient		-3.06		-3.65+		-3.43
		(2.35)		(2.12)		(2.18)
Constant	0.03	11.49	0.22+	-8.81	0.04	7.83
	(0.20)	(19.78)	(0.12)	(17.25)	(0.18)	(18.10)
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	351	246	354	246	351	246

R-squared	0.08	0.14	0.12	0.17	0.12	0.19
Number of States	46	45	46	45	46	45

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness data, Frank (2014) 1990-2013. Sample is limited to state-year observations with achievement gap, revenue, and fairness information. All currency is in 2015 dollars. Revenue and progressiveness measures are logged to reduce skew. Variables labelled "sd" are standardized and measured in standard deviation units for comparison.

Robust standard errors adjusted for state clustering in parentheses. ** $p<0.01$, * $p<0.05$, + $p<0.1$

Table 6: Predicted White-Black Achievement Gaps – Instrumental Variable Analyses
Panel A: 4th Grade Reading

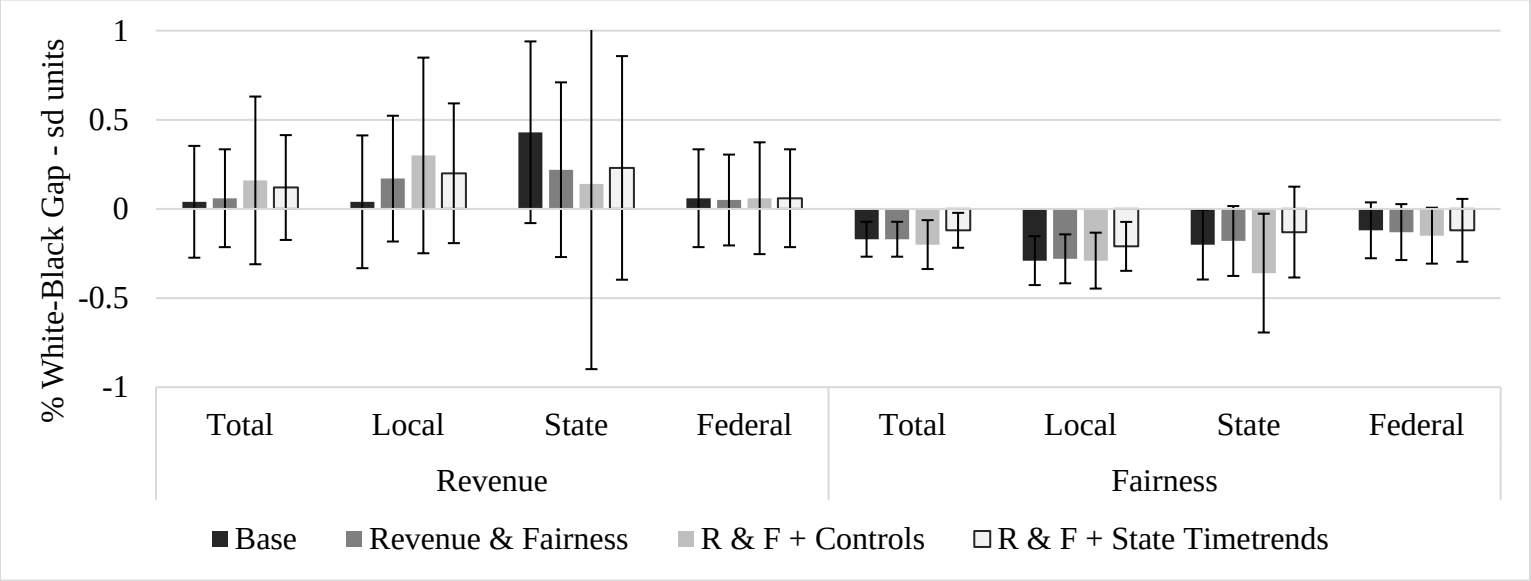
VARIABLES	(1) % White-Black Gap - 1-yr lead sd	(2) % White-Black Gap - 1-yr lead sd	(3) % White-Black Gap - 2-yr lead sd	(4) % White-Black Gap - 2-yr lead sd	(5) % White-Black Gap - 3-yr lead sd	(6) % White-Black Gap - 3-yr lead sd
Progressiveness State & Local Revenue/Pupil (log) - 1-yr lead sd	-0.69*	-0.64*				
	(0.27)	(0.29)				
Progressiveness State & Local Revenue/Pupil (log) - 2 yr lead sd			-1.20*	-1.04*		
			(0.52)	(0.47)		
Progressiveness State & Local Revenue/Pupil (log) - 3 yr lead sd					-0.86*	-0.76*
					(0.34)	(0.33)
Revenue/Pupil (log) - 1-yr lead sd		-0.27				
		(0.22)				
Revenue/Pupil (log) - 2-yr lead sd				-0.40		
				(0.38)		
Revenue/Pupil (log) - 3-yr lead sd						-0.34
						(0.31)
Years Since Last Court Decision	0.04	0.04	0.08*	0.07*	0.02	0.02
	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)
Years Since Last Court Decision ^{2}	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
Cragg-Donald Wald F Statistic	10.30†	12.63†	7.56•	11.04†	7.85•	10.76†
Endogeneity Test	1.93	1.93	2.97+	3.26+	3.31+	3.80+
Observations	192	192	183	183	173	173
Number of States	30	30	30	30	27	27
1st Stage Estimate: Progressiveness on IV	0.49**	0.54*	0.44*	0.53*	0.46*	0.54*

Panel B: 8th Grade Reading

VARIABLES	(1) % White-Black Gap - 1-yr lead sd	(2) % White-Black Gap - 1-yr lead sd	(3) % White-Black Gap - 2-yr lead sd	(4) % White-Black Gap - 2-yr lead sd	(5) % White-Black Gap - 3-yr lead sd	(6) % White-Black Gap - 3-yr lead sd
Progressiveness State & Local Revenue/Pupil (log) - 1-yr lead sd	-0.30	-0.37				
	(0.33)	(0.25)				
Progressiveness State & Local Revenue/Pupil (log) - 2 yr lead sd			-0.27	-0.38+		
			(0.30)	(0.23)		
Progressiveness State & Local Revenue/Pupil (log) - 3 yr lead sd					-0.58+	-0.61*
					(0.30)	(0.25)
Revenue/Pupil (log) - 1-yr lead sd		0.27				
		(0.17)				
Revenue/Pupil (log) - 2-yr lead sd				0.29		
				(0.17)		
Revenue/Pupil (log) - 3-yr lead sd						0.11
						(0.20)
Years Since Last Court Decision	-0.00	-0.00	-0.01	-0.00	0.01	0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)
Years Since Last Court Decision ^{2}	0.00	0.00	0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
Cragg-Donald Wald F Statistic	9.39†	12.30†	7.81•	11.96†	7.64•	10.94†
Endogeneity Test	0.10	0.71	0.06	0.91	1.41	1.77
Observations	174	174	171	171	165	165
Number of States	26	26	26	26	25	25
1st Stage Estimate: Progressiveness on IV	0.48**	0.54*	0.44*	0.54*	0.45*	0.53*

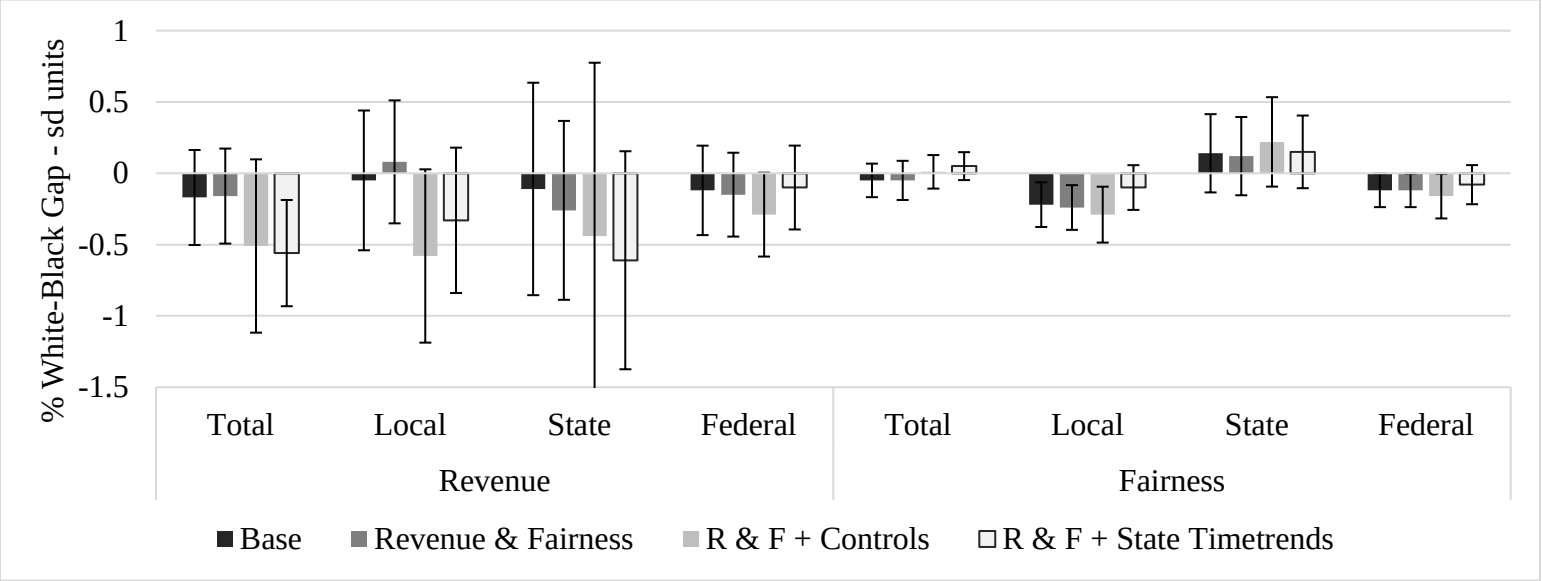
Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness and court decisions data, Rebell (2017) court decisions.
Sample is limited to state-year observations after a school finance court decision. All currency is in 2015 dollars. Revenue and progressiveness measures are logged to reduce skew. Variables labelled "sd" are standardized and measured in standard deviation units for comparison.
Robust standard errors adjusted for state clustering in parentheses. ** p<0.01, * p<0.05, + p<0.1
Stock-Yogo critical value of IV strength exceeded: ‡=10%; †=15%; •=20%
IV is an indicator for whether the last school finance court decision was in favor of greater funding progressiveness or adequacy.
Endogeneity tests are the difference of Sargan-Hansen statistics for two models treating state revenue progressiveness as endogenous or exogenous.

Figure 1: Estimated Relationship between White-Black Achievement Gaps and Revenue Amount and Distribution by Source: Grade 4 Reading



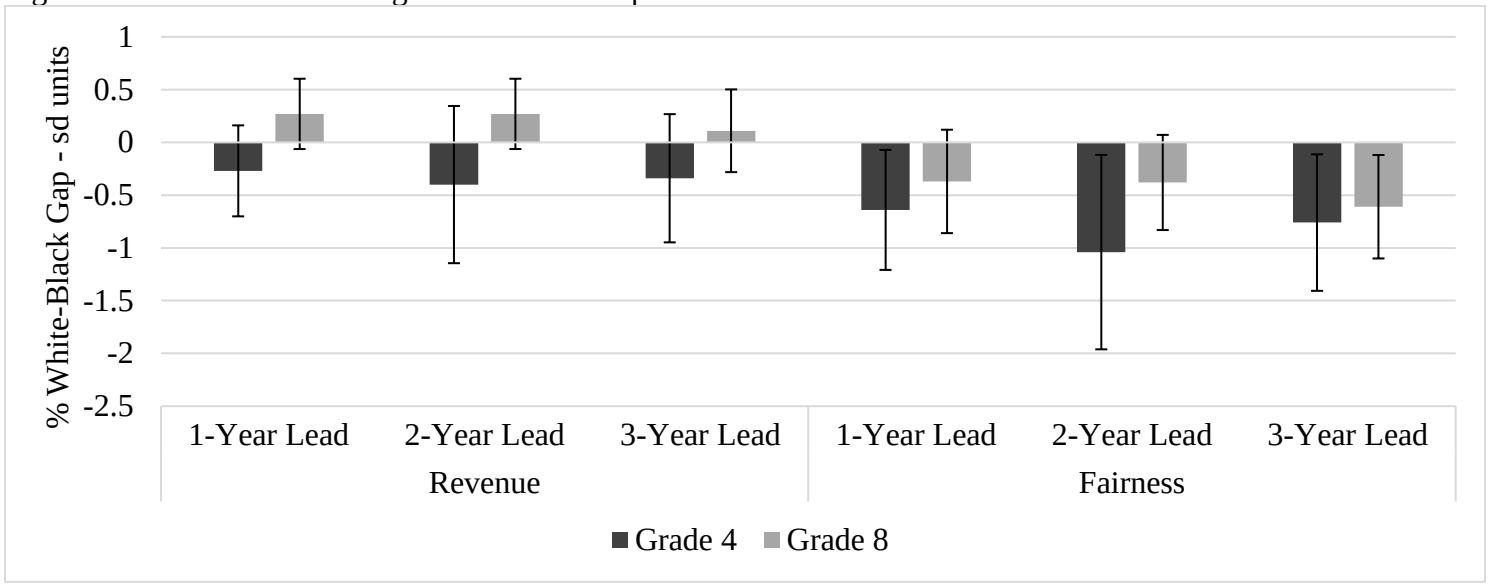
Based on estimates in Tables 4 & 5, Panel A.

Figure 2: Estimated Relationship between White-Black Achievement Gaps and Revenue Amount and Distribution by Source: Grade 8 Reading



Based on estimates in Tables 4 & 5, Panel B.

Figure 3: White-Black Reading Achievement Gaps and Revenue Amount and Distribution: Instrumental Variable Analyses



Based on estimates in Table 6, Panels A and B. Coefficients for fairness are instrumented; coefficients for revenue are not.

Online Appendix

Table A1: Descriptive Statistics: **Math** Achievement

	Grade 4		Grade 8	
Variables	Mean	Std Dev	Mean	Std Dev
% White-Black Gap	10.49	2.70	11.08	2.51
Black:White Ratio (x100)	89.51	2.70	88.92	2.51
Revenue/Pupil	13590.72	3523.64	13241.17	3490.83
Local Revenue/Pupil	5946.77	3489.21	5760.66	3138.56
State Revenue/Pupil	6397.50	2143.28	6241.75	2052.48
Federal Revenue/Pupil	1315.59	519.07	1250.58	509.74
Progressiveness of Revenue Distribution	1.03	0.25	1.03	0.25
Progressiveness - Local Revenue	0.60	0.27	0.60	0.24
Progressiveness - State Revenue	1.77	1.17	1.76	1.16
Progressiveness - Federal Revenue	5.79	3.40	5.54	3.24
State & Local Educ Spending/Fiscal Capacity	0.04	0.01	0.04	0.01
State Share of Total Revenue	0.64	0.21	0.63	0.20
Family Income (Enrolled in Public School)	74041.03	16108.72	74077.73	16330.78
Coverage (% School-Age in Public School)	0.87	0.03	0.87	0.03
% in Charter School	0.03	0.05	0.02	0.04
Average Daily Attendance	1015364	1118243	1058660	1125896
Gini Coefficient	0.60	0.04	0.59	0.04
Year	2007.18	4.63	2006.20	5.58
Last State Supreme Court Case Pro-Fair *	0.40	0.49	0.41	0.49
Years Since Last Court Decision *	7.03	5.43	6.82	5.48
N	340		350	
N *	178		179	

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness data, Frank (2014) 1990-2013. Sample is limited to state-year observations with achievement gap, revenue, and fairness information.

Table A2: Predicted White-Black **Math** Achievement Gaps – Total Revenue and Progressiveness
Panel A: 4th Grade

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	% White-Black Gap - 1-yr lead sd					
Revenue/Pupil (log) sd	-0.10	-0.03			-0.07	-0.04
	(0.17)	(0.17)			(0.16)	(0.16)
Progressiveness State & Local Revenue/Pupil (log) sd			-0.12*	-0.05	-0.11*	-0.05
			(0.05)	(0.06)	(0.05)	(0.06)
State & Local Educ Spending/Fiscal Capacity		-31.57+		-31.75+		-30.90+
		(17.27)		(17.43)		(17.00)
State Share of Total Revenue		0.15		0.12		0.17
		(0.45)		(0.42)		(0.44)
Family Income (Enrolled in Public School)		0.00		0.00		0.00
		(0.00)		(0.00)		(0.00)
Coverage (% School-Age in Public School)		3.10		3.28		3.32
		(2.30)		(2.25)		(2.30)
% in Charter School		-7.92+		-7.60+		-7.70+
		(4.17)		(4.23)		(4.18)
Log Average Daily Attendance		1.06		1.03		0.94
		(0.85)		(0.84)		(0.85)
Gini		-0.51		-0.64		-0.62
		(1.34)		(1.33)		(1.33)
Constant	0.58**	-15.80	0.62**	-15.55	0.60**	-14.41
	(0.09)	(10.89)	(0.09)	(11.01)	(0.09)	(10.88)
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	340	258	340	258	340	258
R-squared	0.23	0.11	0.25	0.11	0.25	0.11
Number of States	47	46	47	46	47	46

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness data, Frank (2014) 1990-2013. Sample is limited to state-year observations with achievement gap, revenue, and fairness information. All currency is in 2015 dollars. Revenue and progressiveness measures are logged to reduce skew. Variables labelled "sd" are standardized and measured in standard deviation units for comparison.

Robust standard errors adjusted for state clustering in parentheses. ** p<0.01, * p<0.05, + p<0.1

Panel B: 8th Grade

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	% White-Black Gap - 1-yr lead sd					
Revenue/Pupil (log) sd	-0.12	-0.03			-0.10	-0.04
	(0.17)	(0.14)			(0.16)	(0.14)
Progressiveness State & Local Revenue/Pupil (log) sd			-0.09*	-0.02	-0.09*	-0.02
			(0.04)	(0.05)	(0.04)	(0.05)
State & Local Educ Spending/Fiscal Capacity		-19.54		-20.08		-19.15
		(14.86)		(15.27)		(14.76)
State Share of Total Revenue		0.33		0.29		0.34
		(0.52)		(0.50)		(0.53)
Family Income (Enrolled in Public School)		0.00		0.00		0.00
		(0.00)		(0.00)		(0.00)
Coverage (% School-Age in Public School)		-3.15		-3.05		-3.01
		(2.36)		(2.36)		(2.37)
% in Charter School		4.66		4.89		4.77
		(4.84)		(4.65)		(4.78)
Log Average Daily Attendance		1.44+		1.49+		1.38
		(0.83)		(0.74)		(0.84)
Gini Coefficient		-2.13+		-2.21+		-2.20+
		(1.09)		(1.13)		(1.12)
Constant	0.36+	-15.26	0.43**	-15.89	0.36+	-14.63
	(0.19)	(11.99)	(0.12)	(10.92)	(0.18)	(12.16)
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	350	248	350	248	350	248
R-squared	0.31	0.29	0.31	0.29	0.32	0.29
Number of States	46	45	46	45	46	45

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness data, Frank (2014) 1990-2013. Sample is limited to state-year observations with achievement gap, revenue, and fairness information. All currency is in 2015 dollars. Revenue and progressiveness measures are logged to reduce skew. Variables labelled "sd" are standardized and measured in standard deviation units for comparison.

Robust standard errors adjusted for state clustering in parentheses. ** p<0.01, * p<0.05, + p<0.1

Table A3: Predicted White-Black **Math** Achievement Gaps – Revenue and Progressiveness by Revenue Source
Panel A: 4th Grade

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	% White-Black Gap - 1-yr lead sd					
Local Revenue/Pupil (log) sd	-0.38*	-0.25			-0.25	-0.24
	(0.19)	(0.22)			(0.19)	(0.22)
State Revenue/Pupil (log) sd	0.43+	0.29			0.31	0.26
	(0.26)	(0.33)			(0.26)	(0.38)
Federal Revenue/Pupil (log) sd	-0.02	-0.03			-0.02	-0.02
	(0.13)	(0.12)			(0.12)	(0.12)
Progressiveness Local Revenue/Pupil (log) sd			-0.15*	-0.06	-0.09	-0.03
			(0.07)	(0.05)	(0.07)	(0.06)
Progressiveness State Revenue/Pupil (log) sd			-0.26*	-0.20	-0.19+	-0.19
			(0.11)	(0.13)	(0.11)	(0.14)
Progressiveness Federal Revenue/Pupil (log) sd			-0.09+	-0.07	-0.08+	-0.06
			(0.05)	(0.06)	(0.05)	(0.06)
State & Local Educ Spending/Fiscal Capacity		-30.34+		-30.48+		-29.03+
		(16.88)		(16.93)		(16.45)
State Share of Total Revenue		-0.26		-0.08		-0.41
		(0.56)		(0.41)		(0.55)
Family Income (Enrolled in Public School)		0.00		0.00		0.00
		(0.00)		(0.00)		(0.00)
Coverage (% School-Age in Public School)		2.70		3.13		2.67
		(2.39)		(2.25)		(2.39)
% in Charter School		-7.84+		-7.94+		-8.11+
		(4.22)		(4.37)		(4.38)
Log Average Daily Attendance		1.02		1.11		1.02
		(0.82)		(0.82)		(0.82)
Gini		-0.78		-1.23		-1.42
		(1.42)		(1.30)		(1.35)
Constant	0.46**	-14.59	0.62**	-16.07	0.50**	-14.21
	(0.10)	(10.72)	(0.09)	(10.80)	(0.10)	(10.69)

State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	334	258	340	258	334	258
R-squared	0.24	0.12	0.26	0.13	0.26	0.13
Number of States	47	46	47	46	47	46

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness data, Frank (2014) 1990-2013. Sample is limited to state-year observations with achievement gap, revenue, and fairness information. All currency is in 2015 dollars. Revenue and progressiveness measures are logged to reduce skew. Variables labelled "sd" are standardized and measured in standard deviation units for comparison.

Robust standard errors adjusted for state clustering in parentheses. ** $p<0.01$, * $p<0.05$, + $p<0.1$

Panel B: 8th Grade

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	% White-Black Gap - 1-yr lead sd					
Local Revenue/Pupil (log) sd	-0.40+	0.18			-0.39+	0.21
	(0.20)	(0.31)			(0.21)	(0.31)
State Revenue/Pupil (log) sd	0.43	-0.12			0.34	-0.21
	(0.36)	(0.35)			(0.36)	(0.49)
Federal Revenue/Pupil (log) sd	-0.17	-0.23+			-0.16	-0.23+
	(0.13)	(0.13)			(0.13)	(0.13)
Progressiveness Local Revenue/Pupil (log) sd			-0.14	-0.02	-0.08	-0.04
			(0.09)	(0.07)	(0.08)	(0.09)
Progressiveness State Revenue/Pupil (log) sd			-0.14	0.12	-0.07	0.12
			(0.15)	(0.14)	(0.15)	(0.14)
Progressiveness Federal Revenue/Pupil (log) sd			0.03	0.00	0.04	-0.00
			(0.07)	(0.08)	(0.08)	(0.08)
State & Local Educ Spending/Fiscal Capacity		-18.38		-20.54		-18.28
		(15.44)		(15.73)		(15.64)
State Share of Total Revenue		0.31		0.44		0.55
		(0.43)		(0.55)		(0.57)
Family Income (Enrolled in Public School)		0.00		0.00		0.00
		(0.00)		(0.00)		(0.00)
Coverage (% School-Age in Public School)		-2.63		-3.09		-2.42
		(2.51)		(2.25)		(2.43)
% in Charter School		5.12		5.15		5.62
		(4.89)		(4.57)		(4.67)
Log Average Daily Attendance		1.35		1.58*		1.37
		(0.81)		(0.75)		(0.88)
Gini Coefficient		-1.61		-1.90		-1.36
		(1.23)		(1.20)		(1.32)
Constant	0.24	-14.77	0.45**	-17.24	0.26	-15.63
	(0.18)	(11.88)	(0.13)	(11.23)	(0.19)	(12.69)
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	347	248	350	248	347	248

R-squared	0.32	0.30	0.32	0.30	0.32	0.31
Number of States	46	45	46	45	46	45

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness data, Frank (2014) 1990-2013. Sample is limited to state-year observations with achievement gap, revenue, and fairness information. All currency is in 2015 dollars. Revenue and progressiveness measures are logged to reduce skew. Variables labelled "sd" are standardized and measured in standard deviation units for comparison.

Robust standard errors adjusted for state clustering in parentheses. ** $p<0.01$, * $p<0.05$, + $p<0.1$

Table A4: Predicted White-Black Achievement Gaps – State-Specific Time Trends
Panel A: 4th Grade Reading

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	% White-Black Gap - 1-yr lead sd					
Revenue/Pupil (log) sd	0.13		0.12			
	(0.15)		(0.15)			
Progressiveness State & Local Revenue/Pupil (log) sd		-0.12*	-0.12*			
		(0.05)	(0.05)			
Local Revenue/Pupil (log) sd				0.15		0.20
				(0.19)		(0.20)
State Revenue/Pupil (log) sd				0.35		0.23
				(0.30)		(0.32)
Federal Revenue/Pupil (log) sd				0.06		0.06
				(0.14)		(0.14)
Progressiveness Local Revenue/Pupil (log) sd					-0.21**	-0.21**
					(0.07)	(0.07)
Progressiveness State Revenue/Pupil (log) sd					-0.15	-0.13
					(0.11)	(0.13)
Progressiveness Federal Revenue/Pupil (log) sd					-0.11	-0.12
					(0.08)	(0.09)
Constant	119.62**	111.21**	119.37**	116.52**	103.07**	110.24**
	(11.25)	(2.80)	(10.95)	(9.70)	(5.18)	(10.05)
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
State-Specific Time Trends	Y	Y	Y	Y	Y	Y
Observations	412	412	412	405	412	405
R-squared	0.56	0.57	0.57	0.55	0.57	0.57
Number of States	48	48	48	48	48	48

Panel B: 8th Grade Reading

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	% White-Black Gap - 1-yr lead sd					
Revenue/Pupil (log) sd	-0.57**		-0.56**			
	(0.19)		(0.19)			
Progressiveness State & Local Revenue/Pupil (log) sd		0.06	0.05			
		(0.05)	(0.05)			
Local Revenue/Pupil (log) sd				-0.38		-0.33
				(0.29)		(0.26)
State Revenue/Pupil (log) sd				-0.66+		-0.61
				(0.38)		(0.39)
Federal Revenue/Pupil (log) sd				-0.08		-0.10
				(0.15)		(0.15)
Progressiveness Local Revenue/Pupil (log) sd					-0.08	-0.10
					(0.09)	(0.08)
Progressiveness State Revenue/Pupil (log) sd					0.20	0.15
					(0.13)	(0.13)
Progressiveness Federal Revenue/Pupil (log) sd					-0.10	-0.08
					(0.06)	(0.07)
Constant	-60.25**	-18.87**	-61.00**	-46.01**	-22.06**	-45.13*
	(15.23)	(6.11)	(15.06)	(15.98)	(6.11)	(17.17)
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
State-Specific Time Trends	Y	Y	Y	Y	Y	Y
Observations	354	354	354	351	354	351
R-squared	0.33	0.32	0.34	0.31	0.32	0.32
Number of States	46	46	46	46	46	46

Panel C: 4th Grade Math

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	% White-Black Gap - 1-yr lead sd					
Revenue/Pupil (log) sd	0.07		0.07			
	(0.16)		(0.16)			
Progressiveness State & Local Revenue/Pupil (log) sd		0.01	0.01			
		(0.09)	(0.09)			
Local Revenue/Pupil (log) sd				-0.30		-0.30
				(0.28)		(0.27)
State Revenue/Pupil (log) sd				0.23		0.22
				(0.35)		(0.40)
Federal Revenue/Pupil (log) sd				0.12		0.13
				(0.12)		(0.12)
Progressiveness Local Revenue/Pupil (log) sd					-0.01	0.01
					(0.10)	(0.12)
Progressiveness State Revenue/Pupil (log) sd					-0.11	-0.12
					(0.20)	(0.20)
Progressiveness Federal Revenue/Pupil (log) sd					-0.01	-0.00
					(0.06)	(0.06)
Constant	28.57+	23.55*	28.20*	26.42	24.41*	25.94
	(14.21)	(8.93)	(13.73)	(18.95)	(10.89)	(19.13)
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
State-Specific Time Trends	Y	Y	Y	Y	Y	Y
Observations	340	340	340	334	340	334
R-squared	0.44	0.44	0.44	0.42	0.45	0.43
Number of States	47	47	47	47	47	47

Panel D: 8th Grade Math

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	% White-Black Gap - 1-yr lead sd					
Revenue/Pupil (log) sd	0.06		0.06			
	(0.25)		(0.25)			
Progressiveness State & Local Revenue/Pupil (log) sd		-0.00	-0.00			
		(0.06)	(0.06)			
Local Revenue/Pupil (log) sd				-0.26		-0.31
				(0.26)		(0.26)
State Revenue/Pupil (log) sd				0.28		0.22
				(0.58)		(0.62)
Federal Revenue/Pupil (log) sd				-0.17		-0.15
				(0.13)		(0.13)
Progressiveness Local Revenue/Pupil (log) sd					0.00	0.03
					(0.09)	(0.10)
Progressiveness State Revenue/Pupil (log) sd					-0.17	-0.14
					(0.14)	(0.17)
Progressiveness Federal Revenue/Pupil (log) sd					0.08	0.07
					(0.07)	(0.07)
Constant	-21.61	-25.80**	-21.45	-29.64	-26.09**	-34.59
	(19.81)	(6.71)	(20.04)	(20.46)	(8.10)	(22.14)
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
State-Specific Time Trends	Y	Y	Y	Y	Y	Y
Observations	350	350	350	347	350	347
R-squared	0.54	0.54	0.54	0.53	0.54	0.54
Number of States	46	46	46	46	46	46

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness data, Frank (2014) 1990-2013. Sample is limited to state-year observations with achievement gap, revenue, and fairness information. All currency is in 2015 dollars. Revenue and progressiveness measures are logged to reduce skew. Variables labelled "sd" are standardized and measured in standard deviation units for comparison.

Robust standard errors adjusted for state clustering in parentheses. ** p<0.01, * p<0.05, + p<0.1

Table A5: Predicted White-Black Achievement Gaps – Current-Year Measures

Panel A: 4th Grade Reading

Variables	% White-Black Gap sd					
Revenue/Pupil (log) sd	0.04	0.07			0.04	0.06
	(0.16)	(0.25)			(0.15)	(0.25)
Progressiveness State & Local Revenue/Pupil (log) sd			-0.07	-0.04	-0.07	-0.04
			(0.05)	(0.06)	(0.05)	(0.06)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	412	253	412	253	412	253
Local Revenue/Pupil (log) sd	0.06	0.02			0.15	0.06
	(0.23)	(0.50)			(0.23)	(0.54)
State Revenue/Pupil (log) sd	0.45	0.43			0.37	0.05
	(0.28)	(0.41)			(0.28)	(0.45)
Federal Revenue/Pupil (log) sd	0.21+	0.18+			0.17	0.13
	(0.12)	(0.10)			(0.14)	(0.13)
Progressiveness Local Revenue/Pupil (log) sd			-0.20**	-0.24**	-0.16*	-0.24**
			(0.06)	(0.05)	(0.06)	(0.06)
Progressiveness State Revenue/Pupil (log) sd			-0.01	0.07	0.02	0.09
			(0.10)	(0.11)	(0.10)	(0.12)
Progressiveness Federal Revenue/Pupil (log) sd			-0.12+	-0.15+	-0.12+	-0.13
			(0.06)	(0.07)	(0.06)	(0.08)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	406	253	412	253	406	253

Panel B: 8th Grade Reading

Variables	% White-Black Gap sd					
Revenue/Pupil (log) sd	-0.05	-0.32			-0.05	-0.32
	(0.20)	(0.30)			(0.18)	(0.30)
Progressiveness State & Local Revenue/Pupil (log) sd			-0.07	-0.01	-0.07	-0.02
			(0.06)	(0.07)	(0.07)	(0.07)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	354	238	354	238	354	238
Local Revenue/Pupil (log) sd	-0.06	-0.67**			-0.01	-0.64*
	(0.23)	(0.25)			(0.23)	(0.24)
State Revenue/Pupil (log) sd	0.12	0.15			-0.01	-0.43
	(0.42)	(0.61)			(0.40)	(0.65)
Federal Revenue/Pupil (log) sd	0.07	-0.03			0.06	-0.03
	(0.17)	(0.15)			(0.16)	(0.15)
Progressiveness Local Revenue/Pupil (log) sd			-0.21**	-0.24**	-0.21*	-0.27**
			(0.07)	(0.08)	(0.08)	(0.10)
Progressiveness State Revenue/Pupil (log) sd			0.18	0.27	0.19	0.26
			(0.16)	(0.20)	(0.16)	(0.19)
Progressiveness Federal Revenue/Pupil (log) sd			-0.06	-0.08	-0.05	-0.07
			(0.08)	(0.10)	(0.08)	(0.10)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	351	238	354	238	351	238

Panel C: 4th Grade Math

Variables	% White-Black Gap sd					
Revenue/Pupil (log) sd	-0.04	0.18			-0.04	0.18
	(0.15)	(0.18)			(0.13)	(0.18)
Progressiveness State & Local Revenue/Pupil (log) sd			-0.09+	-0.04	-0.09+	-0.04
			(0.05)	(0.05)	(0.05)	(0.05)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	340	249	340	249	340	249
Local Revenue/Pupil (log) sd	-0.37*	-0.17			-0.30*	-0.09
	(0.15)	(0.19)			(0.14)	(0.18)
State Revenue/Pupil (log) sd	0.64*	0.69+			0.54+	0.67
	(0.30)	(0.40)			(0.32)	(0.44)
Federal Revenue/Pupil (log) sd	-0.04	-0.02			-0.07	-0.08
	(0.10)	(0.10)			(0.10)	(0.10)
Progressiveness Local Revenue/Pupil (log) sd			-0.14+	-0.10	-0.06	-0.05
			(0.08)	(0.10)	(0.08)	(0.11)
Progressiveness State Revenue/Pupil (log) sd			-0.14	-0.04	-0.07	-0.03
			(0.10)	(0.09)	(0.10)	(0.08)
Progressiveness Federal Revenue/Pupil (log) sd			-0.08+	-0.11	-0.08	-0.13+
			(0.05)	(0.08)	(0.05)	(0.07)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	335	249	340	249	335	249

Panel D: 8th Grade Math

Variables	% White-Black Gap sd					
Revenue/Pupil (log) sd	-0.15	-0.31			-0.15	-0.31
	(0.18)	(0.23)			(0.17)	(0.23)
Progressiveness State & Local Revenue/Pupil (log) sd			-0.05	0.00	-0.05	-0.01
			(0.06)	(0.06)	(0.06)	(0.06)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	350	236	350	236	350	236
Local Revenue/Pupil (log) sd	-0.55**	-0.65*			-0.56**	-0.66*
	(0.18)	(0.31)			(0.18)	(0.31)
State Revenue/Pupil (log) sd	0.52	-0.01			0.48	-0.04
	(0.40)	(0.51)			(0.40)	(0.63)
Federal Revenue/Pupil (log) sd	-0.03	-0.09			-0.01	-0.08
	(0.12)	(0.09)			(0.13)	(0.10)
Progressiveness Local Revenue/Pupil (log) sd			-0.14+	-0.02	-0.05	-0.01
			(0.08)	(0.09)	(0.08)	(0.11)
Progressiveness State Revenue/Pupil (log) sd			0.01	0.10	0.08	0.10
			(0.18)	(0.18)	(0.18)	(0.19)
Progressiveness Federal Revenue/Pupil (log) sd			0.03	-0.01	0.04	-0.01
			(0.07)	(0.10)	(0.07)	(0.10)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	347	236	350	236	347	236

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness data, Frank (2014) 1990-2013. Sample is limited to state-year observations with achievement gap, revenue, and fairness information. All currency is in 2015 dollars. Revenue and progressiveness measures are logged to reduce skew. Variables labelled "sd" are standardized and measured in standard deviation units for comparison.

Robust standard errors adjusted for state clustering in parentheses. ** p<0.01, * p<0.05, + p<0.1

Time-varying state controls are the same as those included in the main analyses.

Table A6: Predicted Ratio of Black to White Achievement

Panel A: 4th Grade Reading

Variables	Black:White Achievement - 1-yr lead sd					
Revenue/Pupil (log) sd	-0.04	-0.18			-0.06	-0.16
	(0.16)	(0.28)			(0.14)	(0.24)
Progressiveness State & Local Revenue/Pupil (log) sd			0.17**	0.21**	0.17**	0.20**
			(0.05)	(0.07)	(0.05)	(0.07)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	412	259	412	259	412	259
Local Revenue/Pupil (log) sd	-0.04	-0.2			-0.17	-0.3
	(0.19)	(0.32)			(0.18)	(0.28)
State Revenue/Pupil (log) sd	-0.43	-0.54			-0.22	-0.14
	(0.26)	(0.54)			(0.25)	(0.53)
Federal Revenue/Pupil (log) sd	-0.06	-0.07			-0.05	-0.06
	(0.14)	(0.18)			(0.13)	(0.16)
Progressiveness Local Revenue/Pupil (log) sd			0.29**	0.29**	0.28**	0.29**
			(0.07)	(0.07)	(0.07)	(0.08)
Progressiveness State Revenue/Pupil (log) sd			0.20*	0.38*	0.18+	0.36*
			(0.10)	(0.18)	(0.10)	(0.17)
Progressiveness Federal Revenue/Pupil (log) sd			0.12	0.14+	0.13+	0.15+
			(0.08)	(0.07)	(0.08)	(0.08)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	405	259	412	259	405	259

Panel B: 8th Grade Reading

Variables	Black:White Achievement - 1-yr lead sd					
Revenue/Pupil (log) sd	0.17	0.51			0.16	0.51
	(0.17)	(0.31)			(0.17)	(0.31)
Progressiveness State & Local Revenue/Pupil (log) sd			0.05	-0.03	0.05	-0.01
			(0.06)	(0.06)	(0.07)	(0.06)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	354	246	354	246	354	246
Local Revenue/Pupil (log) sd	0.05	0.81*			-0.08	0.58+
	(0.25)	(0.38)			(0.22)	(0.31)
State Revenue/Pupil (log) sd	0.11	-0.14			0.26	0.44
	(0.38)	(0.61)			(0.32)	(0.62)
Federal Revenue/Pupil (log) sd	0.12	0.26+			0.15	0.29+
	(0.16)	(0.15)			(0.15)	(0.15)
Progressiveness Local Revenue/Pupil (log) sd			0.22**	0.28**	0.24**	0.29**
			(0.08)	(0.08)	(0.08)	(0.10)
Progressiveness State Revenue/Pupil (log) sd			-0.14	-0.25	-0.12	-0.22
			(0.14)	(0.16)	(0.14)	(0.16)
Progressiveness Federal Revenue/Pupil (log) sd			0.12+	0.18*	0.12+	0.16+
			(0.06)	(0.08)	(0.06)	(0.08)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	351	246	354	246	351	246

Panel C: 4th Grade Math

Variables	Black:White Achievement - 1-yr lead sd					
Revenue/Pupil (log) sd	0.10	0.03			0.07	0.04
	(0.17)	(0.17)			(0.16)	(0.16)
Progressiveness State & Local Revenue/Pupil (log) sd			0.12*	0.05	0.11*	0.05
			(0.05)	(0.06)	(0.05)	(0.06)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	412	259	412	259	412	259
Local Revenue/Pupil (log) sd	0.38*	0.25			0.25	0.24
	(0.19)	(0.22)			(0.19)	(0.22)
State Revenue/Pupil (log) sd	-0.43+	-0.29			-0.31	-0.26
	(0.26)	(0.33)			(0.26)	(0.38)
Federal Revenue/Pupil (log) sd	0.02	0.03			0.02	0.02
	(0.13)	(0.12)			(0.12)	(0.12)
Progressiveness Local Revenue/Pupil (log) sd			0.15*	0.06	0.09	0.03
			(0.07)	(0.05)	(0.07)	(0.06)
Progressiveness State Revenue/Pupil (log) sd			0.26*	0.20	0.19+	0.19
			(0.11)	(0.13)	(0.11)	(0.14)
Progressiveness Federal Revenue/Pupil (log) sd			0.09+	0.07	0.08+	0.06
			(0.05)	(0.06)	(0.05)	(0.06)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	334	258	340	258	334	258

Panel D: 8th Grade Math

Variables	Black:White Achievement - 1-yr lead sd					
Revenue/Pupil (log) sd	0.12	0.03			0.10	0.04
	(0.17)	(0.14)			(0.16)	(0.14)
Progressiveness State & Local Revenue/Pupil (log) sd			0.09*	0.02	0.09*	0.02
			(0.04)	(0.05)	(0.04)	(0.05)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	350	248	350	248	350	248
Local Revenue/Pupil (log) sd	0.40+	-0.18			0.39+	-0.21
	(0.20)	(0.31)			(0.21)	(0.31)
State Revenue/Pupil (log) sd	-0.43	0.12			-0.34	0.21
	(0.36)	(0.35)			(0.36)	(0.49)
Federal Revenue/Pupil (log) sd	0.17	0.23+			0.16	0.23+
	(0.13)	(0.13)			(0.13)	(0.13)
Progressiveness Local Revenue/Pupil (log) sd			0.14	0.02	0.08	0.04
			(0.09)	(0.07)	(0.08)	(0.09)
Progressiveness State Revenue/Pupil (log) sd			0.14	-0.12	0.07	-0.12
			(0.15)	(0.14)	(0.15)	(0.14)
Progressiveness Federal Revenue/Pupil (log) sd			-0.03	0.00	-0.04	0.00
			(0.07)	(0.08)	(0.08)	(0.08)
Time-Varying State Controls		Y		Y		Y
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
N	347	248	350	248	347	248

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness data, Frank (2014) 1990-2013. Sample is limited to state-year observations with achievement gap, revenue, and fairness information. All currency is in 2015 dollars. Revenue and progressiveness measures are logged to reduce skew. Variables labelled "sd" are standardized and measured in standard deviation units for comparison.

Robust standard errors adjusted for state clustering in parentheses. ** p<0.01, * p<0.05, + p<0.1

Time-varying state controls are the same as those included in the main analyses.

Table A7: Predicted White-Black Achievement Gaps – Instrumental Variable Analyses
Panel A: 4th Grade Math

VARIABLES	(1) % White-Black Gap - 1-yr lead sd	(2) % White-Black Gap - 1-yr lead sd	(3) % White-Black Gap - 2-yr lead sd	(4) % White-Black Gap - 2-yr lead sd	(5) % White-Black Gap - 3-yr lead sd	(6) % White-Black Gap - 3-yr lead sd
Progressiveness State & Local Revenue/Pupil (log) - 1-yr lead sd	0.02	0.01				
	(0.19)	(0.18)				
Progressiveness State & Local Revenue/Pupil (log) - 2 yr lead sd			-0.13	-0.14		
			(0.14)	(0.12)		
Progressiveness State & Local Revenue/Pupil (log) - 3 yr lead sd					-0.19	-0.19+
					(0.12)	(0.11)
Revenue/Pupil (log) - 1-yr lead sd		0.07				
		(0.22)				
Revenue/Pupil (log) - 2-yr lead sd				0.03		
				(0.17)		
Revenue/Pupil (log) - 3-yr lead sd						0.00
						(0.16)
Years Since Last Court Decision	-0.01	-0.01	-0.01	-0.01	-0.00	-0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Years Since Last Court Decision ^{2}	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
Cragg-Donald Wald F Statistic	10.63†	13.26†	8.89•	13.35†	8.49•	11.68†
Endogeneity Test	0.30	0.28	0.15	0.31	0.56	0.62
Observations	174	174	171	171	162	162
Number of States	29	29	29	29	27	27
1st Stage Estimate: Progressiveness on IV	0.56**	0.61*	0.52*	0.61*	0.51**	0.57*

Panel B: 8th Grade Math

VARIABLES	(1) % White-Black Gap - 1-yr lead sd	(2) % White-Black Gap - 1-yr lead sd	(3) % White-Black Gap - 2-yr lead sd	(4) % White-Black Gap - 2-yr lead sd	(5) % White-Black Gap - 3-yr lead sd	(6) % White-Black Gap - 3-yr lead sd
Progressiveness State & Local Revenue/Pupil (log) - 1-yr lead sd	-0.41	-0.39				
	(0.37)	(0.38)				
Progressiveness State & Local Revenue/Pupil (log) - 2 yr lead sd			-0.11	-0.12		
			(0.51)	(0.45)		
Progressiveness State & Local Revenue/Pupil (log) - 3 yr lead sd					0.36	0.30
					(0.47)	(0.41)
Revenue/Pupil (log) - 1-yr lead sd		-0.19				
		(0.25)				
Revenue/Pupil (log) - 2-yr lead sd				0.04		
				(0.26)		
Revenue/Pupil (log) - 3-yr lead sd						0.33
						(0.33)
Years Since Last Court Decision	0.01	0.01	0.01	0.01	-0.00	-0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Years Since Last Court Decision ^{2}	0.00	0.00	0.00	0.00	0.00*	0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
State & Year Fixed Effects	Y	Y	Y	Y	Y	Y
Cragg-Donald Wald F Statistic	9.30†	16.13†	9.40†	14.10†	9.01†	12.60†
Endogeneity Test	1.01	1.02	0.10	0.18	0.69	0.48
Observations	172	172	167	167	160	160
Number of States	26	26	26	26	25	25
1st Stage Estimate: Progressiveness on IV	0.59**	0.63*	0.51*	0.60*	0.50**	0.57*

Sources: NAEP 1990-2015, F-33 Census 1990-2015, Baker et al. (2016) 1993-2015 funding fairness and court decisions data, Rebell (2017) court decisions. Sample is limited to state-year observations after a school finance court decision. All currency is in 2015 dollars. Revenue and progressiveness measures are logged to reduce skew. Variables labelled "sd" are standardized and measured in standard deviation units for comparison.

Robust standard errors adjusted for state clustering in parentheses. ** p<0.01, * p<0.05, + p<0.1

Stock-Yogo critical value of IV strength exceeded: ‡=10%; †=15%; •=20%

IV is an indicator for whether the last school finance court decision was in favor of greater funding progressiveness or adequacy.

Endogeneity tests are the difference of Sargan-Hansen statistics for two models treating state revenue progressiveness as endogenous or exogenous.